VIPASSANA MEDITATION

AND THE SCIENTIFIC WORLD VIEW



BY PAUL R. FLEISCHMAN M.D.

This eBook is offered freely. If you wish, you may donate and help us continue offering our services.

To make a donation, please visit: www.pariyatti.org

PARIYATTI
867 Larmon Road
Onalaska, WA 98570 USA
360.978.4998
www.pariyatti.org

Contents

Vipassana Meditation and the Scientific World View

In honor of Acharya Goenkaji

Cover photo by Forrest D. Fleischman

Cover design by Michael Queenland

One of the important factors by which Acharya Goenkaji re-kindled Vipassana mediation in the second half of the Twentieth Century was his emphasis on the similarities between the world views of Vipassana and science. For many Vipassana students around the world, this emphasis facilitated their openness to giving meditation a fair trial. For me, as for thousands of others, Goenkaji's skillful reframing of Vipassana into contemporary language and concepts opened a door, without which I would not have stepped out onto the Path. In honor of Goenkaji's educational mission, which has spanned the planet, I would like to create a brief but serious portrait of the scientific world-view as it unfurled in the Twentieth and Twenty-first Centuries. Once it is clearly presented, the scientific portrayal of reality can be easily understood to clarify such Pali terms as *anicca* (impermanence), *anattā* (non-self, insubstantiality), *kamma* (action, deed) and *Dhamma* (foundation, support, law of nature). Science today not only clarifies some intellectual aspects of Vipassana, but it also adds momentum to the psychological and moral implications of meditation practice.

ABSTRACT

The article fulfills Goenkaji's wish to see *Dhamma* communicated with scientific concepts and language. First, science is defined. Then, a probe is made into cosmology, physics, chemistry, biology, complexity, and information sciences. Each of these fields has contributed to the scientific world-view, and each substantiates and clarifies core aspects of the Buddha's teaching, such as *anicca*, *anattā*, *kamma*, and *Dhamma*.

Awareness of the meaning of the rising and passing of body sensations is established as the meditative gateway to the experience of reality, as defined both by the Buddha, and by the scientific world-view. For the meditator, ultimate understanding comes through the actual practice of meditation. The world is revealed as an organization of complex, dynamic, and fluid compounds in ceaseless flux, following universal laws, by direct insight into which a Vipassana meditator can contact, and receive wisdom from, the *Dhamma*, the information state that guides but is not the same as the material universe.

I — What is Science?

Although science has become one of humanity's premiere occupations, it remains difficult to define. The scientific enterprise encompasses a large array of people, procedures, activities and attitudes. Eminent scientists often define science in different ways. Rather than a single, uniform entity, science is probably best defined as a collection of related and partially integrated events.

The most commonly cited simple definition of science is that of philosopher Karl Popper, who called science the act of falsification. Murray Gell-Mann, who won the Nobel Prize in physics, put Popper's definition into colloquial speech: science is a sentence that can be disproven. This is a common sense reformulation of the definition that often appears in introductory texts on scientific analysis: science is the attempt to gather evidence to refute a pre-existing statement. A hypothesis is formulated; facts are elicited, assembled, and organized in such a way that they refute the hypothesis, or, if the refutation fails, that therefore add credence to the irrefutability of the hypothesis. Despite widespread popular mythology to the contrary, science is not an enterprise of proofs and truths. It consists of ongoing exploration, working formulations, aggregation of data, and reformulations, without any final endpoint. Of course, in particular arenas of inquiry, accumulating evidence may become so powerfully convincing that further inquiry would appear unpromising for new conclusions, and this arena is then tentatively closed, "widely accepted," and colloquially "proven." But as scientific history evolves, old "facts" are overturned. As early as the Eighteenth Century, the philosopher, Immanuel Kant, set the tone for science when he defined it as moderation in our claims, and caution in our assertions.

Because science rests upon human activities, sensory information, and communication, it is subject to the errors that are potential within each of these realms. This does not mean science is flawed, but it does mean that science rests on inevitable and continuous tilting towards self-correction. Science can be defined as continually refined statements that are understood to be the best currently available, yet which are awaiting modification. The unending re-examination process of scientific inquiry is also focused on clarity and simplicity (although the clarity of mathematical symbolic language doesn't always appear so, to mathematically challenged "intuitives!") Einstein famously described science as the rational unification of the manifold, and as the search for the smallest possi-

ble number of conceptually independent elements.

Because an unknown result by an isolated person does not enter into the scientific canon, science can also be understood as a conversation about observable outcomes, which are in the public domain, and which are published in written documents subject to communal examination. On the other hand, because science only exists in the context of society, language, and discourse, cultural constructions may become subtly inserted in ways that are opaque to one generation and which may require modification or excision by subsequent generations. Not only what may be unconsciously assumed, but even what topic is chosen for examination, may reveal cultural bias. Therefore, scientific progress also entails dramatic restatements and rearrangements of what had previously seemed definitive. These "paradigm shifts" also transform our culture, which rests so heavily on apparent conclusions from scientific study. While science may be modest in its claims to having established final "truths", it also must be bold in its thoughts, so that it does not remain embedded in a previous century's beliefs and blindness.

Because journals, books, libraries and public meetings are intrinsic to science, and in spite of its eschewing frozen conclusions, science accumulates and preserves understanding that is woven into previous and contemporary knowledge, until the embedded and linked investigations can be said to form an edifice of tested statements. The logically consistent, empirically tempered web of existing constructs makes the scientific world-view an invaluable resource for reality testing human beliefs and behaviors. If science does not prove, then in the phrasing of nuclear physicist and philosopher Bernard d'Espagnat, science probes reality until it strikes something that says, "No" to our assumptions.

II — Expanding Universe

Among the many moments that we might want to describe as a scientific revolution, the one that seems most shattering and rejuvenating to me is the work of astronomer Edwin Hubble, who, during the 1920's, working on Mt. Wilson, in southern California, first showed that the distant, hazy nebulae were actually other galaxies, and who went on to determine that the universe is expanding. Hubble can be said to have discovered the universe. Before him, the best and brightest, even Einstein, believed they lived in a single galaxy cosmos of fixed positions and dimensions. Hubble expanded our sense of space one thousand million fold (it has grown a lot since then!), and revealed dynamism and change as properties of everything we see. Einstein nobly publicized his own errors and lauded the triumph of Hubble's vision. Hubble gave birth to scientific, observational cosmology out of the domain of astronomy.

If the universe is expanding rapidly and continuously, an inescapable conclusion seems to be that it was once a lot smaller. Extrapolating backward from Hubble's findings, cosmologists constructed the model for what has playfully been called The Big Bang, a universe that about fourteen billion years ago was small, compressed, very hot, and destined to expand. Also using information from particle accelerators and nuclear physics, scientists have created a description of the early universe that is so factually underpinned and convincing that it has no serious alternative hypothesis. Initially, due to unimaginable intensities of heat and compression, even atoms could not cohere, and nuclear matter and electrons existed in diffuse "plasma." Over the equivalent of long human lifetimes but short cosmic time, expansion continued, the world cooled, and most of the visible matter of the universe associated into the simplest atoms, predominantly hydrogen. If you had to define the universe in a sentence, it might be: "Hydrogen atoms clumping together due to gravity." The clumps are the galaxies and stars, too many to count, too far to be seen. There are now thought to be hundreds of billions of stars in hundreds of billions of galaxies, stretching billions of trillions of miles away in every direction. Today cosmology uses other forms of electromagnetic radiation, similar to, but different from, visible light, such as microwave, and infrared, to "see" or contact distant, ancient or light-insensitive parts of the universe, and our sense of space has grown beyond Hubble's, and, as always, science is modifying its previous world view. In modern thought, along with the light-radiating visible stars in their galaxies, there are

black holes, quasars, invisible "dark" matter, non-electromagnetic "dark" energy, and other discoveries and mysteries.

Of particular interest to meditators is the idea, embedded in The Big Bang, that the universe "began." This appears to be disjunctive with the teaching of the Buddha, who said, in the *Bhayabherava Sutta* of the *Majjhima Nikaya*, and elsewhere, that there are many very long cycles of world contraction and expansion. No scientists doubt that the current universe is expanding from a previously compressed state, but the idea that the Big Bang represents a beginning out of nowhere is far from the only tenable viewpoint held by scientists. Other theories include the idea of multiverses – many universes of which our time-space is just one – and of cyclic universes of expansion and contraction. Two very eminent cosmologists from Princeton and Cambridge, Paul Steinhardt and Neil Turok, posit an endless cycle of expansion and contraction, with similar huge time scales (trillions, not billions, of years) to those discussed by the Buddha.

As our universe expands and hydrogen clumps into the galaxies and stars, the gravitational pressure within the stars causes atoms of hydrogen to fuse, and from these fusion reactions emerge two key developments. First, excess energy streams out in electromagnetic forms, which include visible light, which our neighboring plants capture and use for the energy to build the molecules of life here on earth. Second, as series of fusions continue in the hot "furnaces" and "kitchens," as Carl Sagan called the stars, the rest of the elements are formed. The iron in the core of earth, and the carbon atoms that form the backbones of all of the complex molecules, which we call "life," were "cooked" in the stars. Due to the vicissitudes of heat, pressure, and fuel depletion, stars eventually explode, or cool, or undergo other processes that release some or all of their material into space. This stellar stuff may re-congeal into second-generation stars, like our sun, or planets, like earth, or may remain particulate. Nobel Prize winning biologist Christian de Duve has described inter-stellar space, filled with stellar ash of carbon and other elements, as the ultimate source of life-material, "vital dust."

Modern scientific cosmology has awakened us to our location among vast spaces, many places, immeasurably large and potentially alive. Science has re-contextualized human life on coordinates of space and time that approximate infinity and eternity. The domestic and anthropocentric dimensions that blinded the Western world for so long have been deconstructed by the Western world's own scientific advances. While fine points of details may vary, we now recognize that we live in an echoing, ongoing cosmos, towards whose expansive dimensions the Buddha pointed two thousand, five hundred years ago.

III — Compounded Body

The human body is a remarkable compound. To truly understand ourselves, even at the conventional material level, we would have to understand where the atoms of the elements come from, and the basic laws of physics by which atoms cohere; the combinatorial chemistry by which simple atoms associate into multi-atomic molecules; the origin and history of reproducing cellular life here on earth; the evolution of life into the complex multi-cellular forms of which we are one; the development of mind, and of human culture, language, and societies in the context of which our bodies are sheltered, fed, and housed… a very tall order. When we introspect our own bodies with neutral observation, as is done during Vipassana practice, we are peering with the lens of interiorception into the universe with all its matter and laws. We are compounds whose microcosmic location nevertheless mirrors the macrocosm.

Of the atoms in our bodies, about half are hydrogen. Most of our body is water, and, as everyone remembers, water is H_2O, with two hydrogen atoms. In addition, hydrogen is found diffusely in almost all the big biological molecules of which we consist. We got that hydrogen from the Big Bang and its aftermath, the early cooling and expanding universe, when the hydrogen formed, or congealed. Each one of us should celebrate his or her fourteen billionth birthday. Our pebbles and grains are not only unthinkably ancient, they are peripatetic and widely traveled, having made excursions across light years and eons. They are only temporarily vacationing in our blood and bones. Although every person is a different size, and though no one can see so small or count so large, scientific estimates place the number of hydrogen atoms in our body at octillions, that is, 1,000,000,000,000,000,000,000,000,000. Even more remarkably, we don't lose or displace too many of them, a point I will return to in part VIII, where we will consider why it is more common to misplace reading glasses or car keys than any one of your trove of hydrogen atoms.

There are many other atoms in our bodies, the remaining other fifty percent consisting predominantly of common ordinary things like nitrogen, oxygen, sulphur, phosphorus, but preeminently carbon, which forms our branching matrix of complex and vital chemistry. Compared to our hydrogen, these other atoms are newcomers, mostly products of the star that preceded our sun, which blew up its star-stuff into the void maybe six billion years ago, long after the Big Bang, after which gravity re-aggregated our sun

and planet out of the disbursed and floating ash.

In his book, *The 5th Miracle*, physicist Paul Davies, who won the Templeton Prize for scientific discoveries about spirituality, has written that, since the amount of carbon on earth is finite, and since the number of carbon atoms within each one of us is so large, the recycling of carbon atoms into bodies, over the ages "…has some amazing implications. You are host to a billion or so atoms that once belonged to Jesus Christ, or Julius Caesar, or the Buddha, or the tree that the Buddha once sat beneath." Remember that one billion requires sextillion more to grow to octillion, so a billion atoms are actually only a vanishingly minute part of us. Our bodies are built out of Big Bang hydrogen, stellar kitchen carbon, and residues of revelation. We are neither as unique nor as isolated as we sometimes feel. The great moments of the past are within us. In the microcosm of our body, the grains of the universe are re-configured. No wonder we are inspired to meditate when the Buddha is in our blood and bones.

In the warmth of our solar system, in the warmth of our biosphere, in the warmth of our bodies, all tiny things like atoms are subject to the jostling motions of heat due to juxtaposition and collision with their neighboring atoms. Everything that is ordered and regular within us must overcome the random thermal bumper cars of atomic activity within us, which creates a subtle vibration of disorder, and reordering, within the basement of our being. Heat and motion constantly dissolve the order of the world and of our bodies. This tendency towards randomness, dissolution, and decay is called entropy, which many eminent scientists consider to be the most enduring and irrefutable scientific law. The late Sir Arthur Stanley Eddington of Cambridge University, who has been called the greatest astrophysicist of the Twentieth Century, said entropy occupies the supreme position among the laws of nature. Albert Einstein said that the thermodynamic laws, from which the concept of entropy derives, are, "the only physical theory…which will never by toppled." It was in fact the Buddha who first placed entropy in such an emphatic position. His final admonition as he died, as recorded in the *Mahaparinibbana Sutta* of the *Digha Nikaya*, was, "All compounded things decay…"

Entropy, or the dissolution of all compounded structures, like our bodies, is also the quintessential observation that the Vipassana meditator makes as he or she introspectively observes body sensations. Every body sensation signals change, oscillation, decay. Entropy is also considered to be the basis of our sense of time. If not at a conscious level derived from meditation, then at least at a deep intuitive level, we experience ourselves as sliding downhill into disarray and decay, an inevitable destiny we can only partially and temporarily delay. A highly educated friend of mine once told me that the best labo-

ratory for observing the cosmic inevitability of entropy is a teenager's room. He added, "The life of a parent of teenagers is a constant struggle against entropy."

The psychological intuition of the physical and cosmological reality of entropy forms the jumping off place for the world-view of both science and Vipassana. Both science and Vipassana place at the premier position the observation of transformation, dispersal and degeneration.

But where and how did the ordered workings of ourselves derive? If everything is winding down, how did it ever get wound up? In section VIII, when we consider how science describes *Dhamma*, we will see how we have emerged as a standing eddy in the stream of time. We are temporary, compounded order in a world of entropy. Our ordered, reliable forms locally reduce entropy, while actually increasing it on the universal balance sheet. And not everything is compounded matter.

IV — Enclosed Individual Life

Like the Buddha, Einstein saw humanity imprisoned in a delusion, like an optical trick of mirrors, which produces a false sense of self. This false self derives from a misinterpretation about our apparent separation from the world. Inside our skin, we imagine, is "us;" outside is "other."

Life by definition uses enclosure. Unlike physics or chemistry, biology is the study of cells, which are compartments of semi-permeable separation from the rest of the world. From bacteria to humans, all living beings are cellular (viruses are not complete cells, but they require the cells of other beings in order to complete their life cycle). Only within the partial safety and structure of cells can the complex chemistry of life evolve. Simultaneously, cellular life is vital, fluid, in constant communication and exchange with its environment. Life is a partial boundary that always involves transit, and a temporary enclosure that always dissolves.

Although counting the number of cells in our bodies is impossible, scientists estimate that we contain between ten and a hundred trillion cells. If you started at birth, and lived to be 80 years old, and counted two numbers per second without sleeping or doing anything else, you wouldn't be able to count one one hundredth of your own cells. We are much more complex than is generally appreciated. Since our cells are constantly dying and being replaced, some slowly, like brain and bone, some rapidly, like skin and blood, we manufacture an estimated quadrillion cells in one lifetime. This flurry of temporarily counter-entropic creation makes us a hubbub of sensational activity. Materials of old cells are being recycled. Energy and new materials arrive from our food, which must be broken down and re-tooled. Via the plants we eat, new atoms in the clustered form of molecules are imported from the earth's library of materials, which are in turn borrowed from our old universe.

When we make new cells, it is always from the information contained in the DNA of previous cells. This story, generally referred to the 1953 Nobel Prize work of James Watson and Francis Crick, and roughly familiar to everyone, is actually the product of investigation by armies of chemists and biologists during decades of the Twentieth Century. Even as recently as 2009, the Nobel Prize continued to be about new discoveries affecting the chromosomes that hold DNA, and about cell division. Remembering that we start with one cell, containing DNA from both father and mother, and then rep-

licate that in quadrillions of divisions, the integrity of human life is as amazing as the cosmos, which contains only its mere trillions of stars, for we are not only numerous, but also intricate and precise to a degree that we ourselves are challenged to comprehend. Since human DNA contains billions of messages, or information bits, science writer Matt Ridley estimates the human genome to be as large as 800 Bibles. Since replications occur over so many years and quadrillions of times, you would think there would be a lot of errors. Why don't our ears turn into cauliflowers by mistake, and our fingers into squids, or, more likely, why don't we gradually morph, according to the laws of entropy, into cancerous, dissolving, decaying chemistry sets? Of course, we eventually do. But during the interval of our lifetime, we not only suffer billions of mutations, both from replication errors and also from environmental assaults, but we rectify the errors with corrective, proofreading chemical systems of incomprehensible precision and fidelity.

Human life uses, preserves, and transmits information in our bodies at orders of magnitude greater than we have capacity to think. During our lives, our bodies hum and buzz not only with thermal jostling and entropic decay, but with replication, construction, addition and repair. We make people out of cosmic atoms that are channeled by the earth's biosphere into plants, whose own cellular energy we bio-transform into ourselves through non-stop, guided, highly accurate creation. The replication and creation of cell from cell is based upon a host of large, complex molecules, which accompany, guide, and fulfill the information within DNA. Ironically, the array of macromolecules, which are necessary for cellular replication, must themselves be replicated each time that the cell is. And in trillion-celled creatures like us, cell replication must also follow critical, unerring, sub-choices, during which brain cells create more brain cells but no liver cells, or heart muscle cells produce more of themselves but not kidney cells. This differentiation into cell type requires further detailed molecular tooling. For every individual person, this entire process is read out from unique DNA, a person-specific bundle of traits that have traveled down the ages to form this one life. Our *kamma* is ancient; our DNA is our own signet ring.

It is easy to see why a certain vanity of self-manifestation seems embedded into living beings. It is easy to see why we might come to overemphasize our creation rather than our entropic destiny. During its tenure, life is a proliferative activity without pause or stasis. When we meditate on body sensations, we experience, along with entropic jostling, "time's arrow," the quadrillions-fold frenzy of life in creation.

All of this change, by which atoms are rearranged into the molecules and cells of life, requires energy. We get our energy by eating plants, who in turn, have caught, in their

outstretched greenery, the solar electromagnetic energy, light, radiated outward from nuclear fusion reactions among the solar atoms suffering gravitational compression. From force of gravity, from the insides of atoms, the universe donates light, from which we make the tens of thousands of complex and specific chemicals that form us. But exactly how do we turn light into brains and toenails? The process is complicated, and requires passing high-energy electrons, like hot potatoes, down a chain of (you guessed it!) very complex molecules. We experience this electron transfer every moment through respiration, the use of oxygen, which is the molecule that at last accepts and holds the now energy–reduced electrons at the end of their energy-releasing chemical journey. Even as simplified as is my description here, three features deserve our attention:

1. We are the movement of photons, sunlight. We are electrons in motion. We are energy transiting chemicals. Our essence is energy transformation and change, energy from atoms and stars, change guided by the long aggregation of information stored by life, over billions of years, into the libraries contained in cells, DNA and its allies. We are the passage of electrons flowing through macromolecular chemistry. We are the transformation of electromagnetic energy, taken from the atoms of the universe, into vital chemistry, called life. We are energy from the universe re-arranged by eons of *kamma* into us.

2. Because our energy utilization requires oxygen, and because oxygen is not a native feature of earth, but is itself the creation of earlier and other forms of life, like blue-green algae, or trees, who know how to catch the solar photons and store their energy in chemicals, like chlorophyll, we ourselves are saprophytes, dependents. We suck the oxygen made by our ancestor and contemporary plants. We exist and thrive only under the life-made ocean of air. Like amoebas swimming in a drop of water, we are a part of the earth biosphere. Every moment of our lives we breathe in and out, in exchange of energy, atoms and molecules. We share with, and depend upon other lives: exchange and change. All of life is our mother. As recipients of life's potential, reverence for life becomes self-evident, even self-serving, wise.

3. Our use of energy is entirely unlike energy transformation in the world of physics and chemistry, such as fire, or thermonuclear reactions. In biology, in us, energy is parceled out in precise, discrete units, quantified, with attention to

detail. Random, explosive, or ionized, charged energies destroy us. For us, the energy we get by carrying electrons down chemical pathways always remains in specific chemical bonds. By making or breaking these designated bonds, we store and release exact amounts of energy in exact times and places. Life is vigilant, constrained, and channeled use of energy within chemistry. And about how many of these quantified, chemical, energy reactions do we make and break? Millions per second per cell, in trillions of cells. Yes, there are quintillions or so of energy-exchanging chemical bonds made and broken in your body every second! We can say that the Pali term, *anicca* (impermanence) is firmly anchored in biology. The number of energy transformations within us defies comprehension, is ceaseless change. We can add that the dynamics of biology creates numbers that we can tabulate, but to which we cannot really relate. To "understand" the energetic, transformative nature of our bodies, we require a more direct experience than our cognitions. Generally, people experience themselves as existence, something, a being, stuff. But when we self-observe systematically, continuously, and realistically, during Vipassana meditation, we experience rapidly oscillating sensations of fluid, light and flow.

V — A Brief Look at "Mind"

A brief, summative overview of the science of mind cannot be written, as there is no generally agreed upon scientific hegemony regarding it.

The commonest view is that mind derives from the switches and connections in the railroad yard of the brain. The potential numbers of interactions are impressive. Our brain cells are also estimated to exist in the trillions, and because many of them are networked to many more, there are estimated quadrillions of possible combinations of networked cellular interactions available to brain function. Nevertheless, networked interactions of large numbers of events, though they may seem to account for cognition or memory, do not seem related to creativity, imagination, insight, or spiritual vision. Networks of neurons can easily be thought of as loci of storage, organization, or re-arrangement. But can they synthesize, imagine, create?

Many theories of mind include, along with the biology of the brain, dimensions of physics that might account for the more numinous aspects of mental function. As Einstein reflected, why do our minds seem to have such deep and fundamental connections to the universe? Why do human creations, like mathematical formulas, seem to correspond so well to aspects of nature? Other great scientists have also puzzled about the apparent link between human thought and scientific regularities. The Tamil-American astrophysicist, Dr. Subrahmanyan Chandrasekhar, winner of the 1983 Nobel Prize in physics, observed that the human mind appears to be not only intellectually and mathematically synchronized with deep layers of natural truths, but even aesthetically, we find revelations of natural law to be satisfying and "beautiful." Dr. Chandrasekhar concluded that what we call "beauty," is often an expression of a universal "truth."

Intuition, or meditation, seem to bring us "in touch" with realities even beyond thought itself. Is "mind" a mere biological adaptation, a product of function and survival, or does it tap a more fundamental layer of existence, a pre-biotic knowing? Is mind a product of life, or is mind a function of the world in which life itself is embedded?

A number of prominent biologists, particularly those who study complexity, like Stuart Kauffman, Werner Loewenstein and Harold Morowitz, have tried to explain mind as a deeper structure that is organized and amplified by the brain, but which predates humans, or life, or earth. They take as their starting point the exclusion principle for the elucidation of which physicist Wolfgang Pauli was nominated by Einstein for, and then

got, the Nobel Prize.

Pauli, one of the elite leaders of quantum physics, asked why matter doesn't clump, smash and shatter upon itself. Why is matter so reliably structured? Why doesn't gravity make the universe into one giant compressed ball (or black hole)? Why don't the numerous electrons that are found in larger elements, like our own essential backbone atom, carbon, bang into each other, creating a universe of chaotic ionized plasma, rather than reliable atoms? Pauli pinpointed how electrons are exclusive. Despite the fact that electrons are not little things, but are complex waves or particles or probabilistic distributions of energy, they nevertheless have uniqueness. Electrons have a spin, a signature or fingerprint. Each electron not only seems to know its own name, but also seems aware of other electrons. By uniqueness in energy level and spin, electrons maintain separation from each other, an exclusion principle within the deepest structure of matter that keeps things separate in their proper cosmic role.

Complexity theory biologists, like Kauffman, Loewenstein, and Morowitz, see in Pauli's exclusion principle "the root of the organization of the universe." Matter is intrinsically aware. Relationship – awareness of the "other" – is built into matter. There is an intrinsic coherence, wakefulness, connectedness in things. The human mind may not be a unique creation, merely a unique amplification of properties of mind that are as universal as protons and electrons and atoms. Matter knows something and is not mere stuff. Or so it may be.

The Buddha taught that mind is independent from, but mingles with and contacts matter. The combination of the two forms life. At the leading edge of science, theorists who have abandoned the brain-centered model of mind are catching up with him. For the Buddha, consciousness is multiple, and impersonal, a property of each sense organ's interaction with the external world. While we cannot say scientific confirmation exists for this, we can say that advanced biophysicists present us a way of looking at mind, and consciousness, that is impersonal, universal, independent from, and pre-existing any superimposed "self." We may be "aware" with down-loaded features of the universe. Though we may have generated its content, we may not be the owners of our mind itself. Mind may be a pervasive, lawful expression of contact. Morowitz has written: "…entities show in their togetherness laws of behavior different from the laws that govern them in isolation…it is as if the second electron knew what state the first electron was in…a curious noetic character."

Johannes Kepler, the great astronomer who paved the way for Newton and the scientific revolution, may have had a similar idea when he said, in the early 1600's, "Geome-

try existed before the creation."

Because mind may well be located in relationship, in interaction, in connection, even within the context of the human body alone, mind needs to be reconsidered. The brain may be best thought of as necessary, but not sufficient for, mind, which, for example, may also require sense organs, DNA information, circulating hormones and peptides, supportive cardiovascular function, in short, the whole person. The unique perceptivity of humanity may well be based upon the complex connections we contain within all of our trillions of cells, of which brain cells may be exemplary but not exclusive. Deep sensations of mind, in contact with body, may utilize universal features of awareness. Mind may not be an interaction of brain and body, but contact of mind itself with every atom of the body. Mind may consist of an organismic integration of a whole mind contacting a whole body. Mind may not be located in one organ, like the brain, but may be a non-reduceable function of the whole universe, with its matter and laws, represented in a whole, integrated person. It may well be that in wholistic totality, and in penetrating detail, mind and body interact, from which our personal mind springs. Vipassana meditation practice reveals that mind has an interactive connection to the body, in its entirety, and in its detail. Don't miss your toes.

VI — Beneath Matter and Energy

The Greeks thought matter and energy formed the world. In his "miracle year" of 1905, Einstein wrote $E=mc^2$, and showed that matter could be converted to energy. Matter and energy are aspects of each other. What does the world actually consist of? What lies beneath, or between, matter and energy?

The world can in theory be unified, understood in the simplest and most complete way, by finding an ultimate building material, or a final and singular law. Science has not accomplished either of these goals of simplification and unification. Einstein spent decades searching for the unifying law, and could not do so. Murray Gell-Mann described the subatomic protons and neutrons as consisting of even smaller particles, which he mischievously dubbed "quarks," but today many forms and flavors of quarks are thought to exist alongside of other minute sub-atomic entities – a porridge rather than a diamond. String Theory proposes that the world is built by entities that contain more dimensions than our human senses or thoughts normally interact with, but this theory is far from general acceptance. Our best scientific thoughts, about the arising and vanishing matrix of the material universe, derive from quantum physics, which was developed in the Twentieth Century by a pantheon of superheroes including Max Plank, Einstein, Neils Bohr, Werner Heisenberg, Wolfgang Pauli, Max Born, Paul Dirac, and Erwin Schrodiner.

When science explores the tiny things of which the universe is compounded, it finds a world different from the one about which our senses inform us. Our sense organs, and the logic that is built upon the information which they provide us, is useful, but not ultimately accurate. Concepts like "objects," "particles," "energy," "waves," must be jettisoned. They are merely gross, utilitarian approximations. Light, for example behaves like both a wave and a particle. Things, like electrons, are less like tiny discrete particles, and more like clouds of varying density, locales where they are more or less likely to be encountered. The bedrock of the universe seems probabilistic. Events, entities and laws are probable or improbable, rather than existent or non-existent. There is a large degree of lawfulness, predictability, and order in the way that the tiny stuff of the subatomic world behaves, but also a degree of unpredictability and fluidity. Einstein's agonized protest against this more numinous quantum science, of which he himself had been the pioneer, but which he ultimately rejected, was, "The Old One does not play dice." But

today, the scientific vision of the world leaves little doubt that the world's base is oscillatory rather than static, fluid rather than fixed, creative rather than stuck. Change and opportunity seem built into the finest level of matter, energy, and law. Matter is fundamentally energy, motile, oscillatory, smeared out in clouds rather than embedded in hard balls.

There is a famous saying that, if you think you understand quantum physics, then you don't. We can't be smug noticing how easily the quantum physical world intersects with the Buddha's description of reality, because quantum physics requires a lifetime of mathematical penetration, and because its conclusions remain very subject to change and reinterpretation. There has been a trend to give facile confirmation to philosophy derived from Buddhist schools by invoking partly understood discoveries of quantum physics. In "quantum entanglement," under highly specific conditions, two "particles" born from the same experiment, seem to communicate instantaneously, faster that the speed of light, and they seem "entangled", or unified across space and time. Einstein argued that such "spooky action at a distance" was merely an artifact of experimental error, but, as the Twentieth Century progressed, unimpeachable scientists at CERN in Europe, and elsewhere, like Alain Aspect, John Bell, and Bernard d'Espagnat have created both experiments and theory that lend credence to the idea that in some deep structure of reality, apparently separate events may be "entangled" or connected. But these specific experimental phenomena, in very limited domains of applicability, hardly prove there is an underlying implicit wholeness influencing our lives. Similarly, the idea that the whole universe exists microcosmically in a single atom overlooks the world-shaping power of interactions, which we have already seen in the exclusion principle, and which we will consider next. Many scientifically observable regularities, "laws of nature," are not found in every atom, nor in every grain of sand, but derive from the integrated interactions that emerge from the whole.

While quantum physics itself remains unfinished, and provocative, rather than conclusive, we can comfortably accept that in his moment of revolutionary realization, due to practicing Vipassana, the Buddha entered a world of vibrations. From studying quantum physics, with its energy-matter interconversions, particle-wave duality, smeared–out probabilistic electrons, distantly resonating electrons, recedingly minute and various quarks and muons, we cannot claim to have expertise in the nuanced and receding corridors of the ultimate. But we can follow the Buddha's meditative, introspective methodology down to his remarkably simple, unifying, scientifically-compatible description, of the farthest we can go. If it is not a final conclusion, it is also not an unreasonable

or “new-age” statement, to say that the material world consists of vibrations rising and passing away.

VII — *More is Different*: Complexity

More is Different was the title of an article that physics Nobel Prize winner Philip Anderson published in Science in 1972. It is often taken as the moment when complexity-theory hit the scientific front page.

The universe is a self-interacting system. Its components encounter and influence each other. Forces like gravity clump matter; matter engages matter according to the laws of physics and chemistry. Stars are drawn into being by gravity out of cosmic dust; compounds, molecules, living beings emerge on our planet, resonating, as we have seen, with vast numbers of interactional events. In our own bodies alone, the number and variety of interactions defies our computational understanding. So it is very obvious that the world is complicated, that the universe and its life forms arise from complex events. But complexity theory carries us further.

Within the context of innumerable interactions that form our body, or that animate the world, the complexity of the systems may not be merely additive. The greater the number of atoms and lawful regularities involved, the greater the complexity, true; but complexity often appears to increase in another, faster way, as if events did not merely add to events, but multiplied each other, or amplified the system in exponential growth of complexity, or, most importantly, engendered creative leaps into entirely different domains of highly complex new realities. More events, and more interactions, do not just drive more events and interactions of a similar nature. More events and interactions create entirely different phenomena. The universe contains lawful regularities, scientific laws that emerge at new levels of complexity. The universe exfoliates out of itself, gradually revealing increasingly complex new events, gradually expressing new potential arrangements of matter and energy that are radically different from those which can be observed at lower levels of complexity. The world is less like a stepladder, more like an upward spiral.

There has been an enduring debate between determinists, like Einstein, who believed that every event is caused, and those who believe in free will. Complexity theory forges a middle path. The universe does not violate its intrinsic lawfulness, but the lawfulness engenders such complex phenomena, like human beings, like the human mind and will, that lawfulness can give birth to creativity and freedom. The quadrillions of synapses in the human brain, as well as the other potential forms of communication in the embodied

mind, like circulating hormones and peptides, as well as a possible role for quantum events like exclusion and entanglement, within the context of the mind, create a system of such high order potential, that insight, realizations, options and choices may arise out of the sesquillions of vibratory interactions among the cosmic and stellar ash of hydrogen, oxygen, carbon. In Anderson's view, at each order of complexity, entirely new phenomena emerge. We cannot study atoms, molecules, and cells, and claim to understand life, or mind. Higher order events, life and mind, do not violate the universe's laws, but they cannot be reduced to the laws of physics, chemistry, or even cell biology, because, as their complexity increases, new universal laws emerge as part of that complexity. Life and mind express laws that are consistent with, but much more complex than, physics and chemistry. In humanity (even in amoebas) something new and different has emerged, following emergent lawfulness, whose sweep of rapidly integrated, uncountable interactions may permit insight, choice and freedom.

Complexity theory permits an integrated world-view that contains causality and creation. This view echoes two aspects of Vipassana: the explanations of cause in the *Abhidhamma*, and the Buddha's emphasis that we create ourselves.

For human beings, across millions of lifetimes (or even across fifteen minutes) there are so many thoughts and emotions, so many volitions, that no single cause ever entirely constitutes the mind (until it is totally purified). Instead, as we read in the *Comprehensive Manual of Abhidamma*, "there is always a collection of conditions giving rise to a collection of effects." Multi-causality and complexity dominate our unpurified nature, and also offers multiple opportunities. Through the very long bead chain of mind moments, we follow the deterministic pressures of cause, leading to effect, leading to a new cause. We also contain the creative potential of complex multi-causality, and cause ourselves. We are our own father and mother, as the Buddha phrases it. We are the hydrogen of the Big Bang, and the carbon of the last supernova, but we are more, and therefore different.

There need be no "soul" or "world soul" floating in some disembodied fantasy realm exempt from scientific law, to explain our suffering and our Path away from suffering. Instead, using scientific language, we can say that we are highly complex, integrated, lawful impersonal, universal emergent phenomena. The order of complexity within us is such that self-observation can arise. Self-observation triggers insight into ourselves as Karmic bundles of iterations of universal cause and effect. Insight triggers the capacity to optimize self-creation through right understanding and right action. We are complex systems, built on universal law, who can observe, understand, and use the causality that caused us, to steer our future.

When we are meditating, the pyramid of number-busting complexity of atomic interactions within a human being permits the emergence of a new set of phenomena and laws. The phenomena are insight, realization, and Path factors, such as *sīla* (values), *samādhi* (concentration) and *paññā* (wisdom).... They are the Path out of suffering. The Path emerges out of, and consists of, universal law.

VIII — Informatic Universe

We are lucky to live in "The Information Age." Our luck does not consist in our increasing obeisance to those tyrants of instantaneousness, the computer! We are lucky that the concept of "information" gives us a new integration of science with *Dhamma*.

Aside from the fact that probably everyone who reads this article lives at least partly chained to a computer, information has dominated this earth-era. Leo Sziland created the modern concept of information. He also was the physicist who, fleeing Europe, intruded upon Einstein's attention the Nazi's plan to build nuclear explosive devices under the guidance of their Nobel-Prize winning physics colleague, Werner Heisenberg. Under Sziland's provocation, Einstein notified Franklin Roosevelt, who instantly commissioned the Manhattan Project. Information is not independent from human suffering.

But Information Theory, elaborated seminally at Bell Laboratories by Claude Shannon, and by Einstein's Princeton colleague, Jon Von Neumann, and by Bertrand Russell's mathematical protégé, Norbert Weiner, has reshaped our understanding of the scientific enterprise itself. The universe does not consist of matter and energy, nor space and time, nor strings, superstrings nor random vibrations. The universe is the manifestation of information. We live in an informatic universe. The Buddha called it *Dhamma*.

"Information" means selection criteria that limit choice. If you have information that New Delhi is north of Hyderabad, and you are in New Delhi, you know that you must (are limited to) go south to get there. Information limits how electric currents can traverse a computer, and therefore what paths the electrons must, and cannot, take. The scientific laws, which guide the universe, are information. Gravity told Newton's apples that they must fall towards the earth. Evolution limits biological choices by selecting for adaptive ones, and can be understood as a source of information for life, about the necessary direction of its flow.

Information is not in the universe, as if there were once a universe of caprice into which information had later been injected. No matter how far back we trace cosmic background microwave radiation from The Big Bang, or any other phenomena, we find scientific law, or information. The universe unfolds with information. As it evolves, its complex set of laws emerge. As we have seen, some laws, like quantum laws, only give probabilities and likelihood, while other laws, like gravity, appear deterministically ironclad. Pure randomness, if it exists, does so only within domains of law and therefore

is only local and partial lawlessness; that is, randomness is a constrained lawful variant permitted by prevailing law. Randomness provides a pool of variation for incorporation into the unfolding order and creation of the cosmos. The pervasive, unwavering, orchestrating natural information state of the universe is what the Buddha called, "*Dhamma*."

DNA provides some of the information for our current bodies. But our personal, fingerprint — unique DNA — is itself predicated on the information embedded in evolution by natural selection. DNA operates within us according to rules imposed upon it by chemistry law. All chemical bonds, including those in DNA, use the electromagnetic plus and minus, by which atoms form larger molecules. The activity of atomic nuclei and electrons are the moving parts by which the great 800 Bibles worth of DNA information operate.

Within us is every universal law. The operation of our unique DNA sequence is predicated upon biological evolution, cell function, combinatorial chemical rules, the physics of basic forces, and quantum probabilities. It takes the universe to make a person. Within us is the strong nuclear force by which atomic nuclei cohere. Within us is the Pauli exclusion principle by which electrons maintain their identity. Within us are four billion years of stored up information bits in our DNA, which is simultaneously universal cosmic law, and uniquely individuated, person-specific *kamma*. We move photons from solar energy down electron transport staircases, which are made of cellular macromolecules, using the information of the universe's physics and chemistry, to capture units of the sun's release of energy, and of information. Every bit of sunlight is a solar photon that enables us (if plants capture it, and if we eat the plant) to say, "yes" or "no" to a chemical pathway whose process helps to form us.

It is the aggregation, interaction, and complex organization of cosmic regularities that we label "physics," "chemistry," "biology," etc, which place the octillions of atoms of which we consist in their precise functional places. The information state within us, the universal law, the *Dhamma*, locates these more-than–galactic numbers of atoms into slots measurable by hundred millionths of a centimeter! Of course, mutations, errors, disease occur, but the fidelity of life processes is both vast in number and exquisite in calibration. Too bad we can't just hand over our car keys and cell phones to our internal master of ceremonies, the *Dhamma*.

The original realization of the informatic universe occurred under the Bodhi Tree and was promulgated by the Buddha. He described a universe of natural law that guided the ultimate particles and vibrations of the material realm. The material world does not exist either by whim, nor by a "self." It is an information state, a compound of incalculable

amounts of information. Humans can understand this information by reason, and can experience its processes within themselves through Vipassana meditation practice. We contain the information state of the universe. On the minute scale it drives the arising and passing of our material constituents. On the large scale, it is the laws of *kamma* by which a banyan seed, according to biological law, produces a banyan tree.

The *Dhamma*, the information state within the universe and within us, is the aggregated complexity of scientific law. When we persevere in observing it moment by moment, we pull alongside of it the way Einstein famously imagined himself traveling on a beam of light and thus came to insights about the laws of special relativity.

Finally, we have to deal with the fact that there seems to be a contradiction between two descriptions of the world that derive from contemporary science. The world is informatic, Dhammic, lawfully following the limitations of cause and effect (sometimes deterministic, "tight cause," sometimes quantum probabilities). But the world is entropic, decaying, running from order to disorder, from compression to dispersal. The world is unwinding. Information means limitation and organization. Entropy means randomness and disarray. We have seen that both operate in our bodies: we uphold and maintain complex arrays of octillions of atoms, until we decay, accumulate errors and disease, and die.

Science answers this conundrum in many ways. Some believe that the universe, similar to a human body, is winding down like an old-fashioned spring clock. Most point out that high levels of order, like life on earth, are small, local eddies of order, temporary circular flows of high-density information, sequestered in tiny corners of a vast, expanding, almost entirely empty universe, which consists predominantly of empty space devoid of matter or pattern at all. Stars and galaxies and matter occupy a very small percent of the cosmos. In any case, life on earth, taken as a whole, follows the laws of entropy, because it uses up energy and spews out waste – heat – which overall increases the total quantity of disorder in the world, while only temporarily increasing local order on earth. (Global warming can be understood as one expression of expanding entropy secondary to the increased activity of life.) All of these explanations are based on the questionable idea that the information state of the universe is found only in matter itself, and that the universe began at the Big Bang and is subsequently expanding and winding down.

But we have also seen alternative hypotheses arise from Twenty-first Century science. The Big Bang is not an origin but a phase. The information state of the universe, The *Dhamma*, has no origin, no end, does not "run out" as cosmic matter dis-aggregates and expands, because there are larger cycles involved (which might be better measured

in trillions, not billions, of years) and because information is not the same as the matter in which the information manifests. Within our particular cycle of time, the information and vibrations interact, and complexify, through overlapping multitudes of contact between them. New degrees of order emerge. From simple things like carbon, water, and sunlight, life emerges, people emerge.

Compounds are entropic. The information state is not. All compounded things are subject to decay. The *Dhamma* is not a compounded thing, and is not subject to decay. The Vipassana meditator watches with equanimity the arising and passing of their embodied sensations, and observes both entropy – the decay of all compounded things –and the guiding presence of *Dhamma*.

The universe was not built for the favor of our egos. It contains death and destruction. Its information can lead to atomic weapons on earth and to engulfing supernovae explosions and black holes in the cosmos. But when we pull alongside of its *Dhamma*, ride along beside it, watching with equanimity its materials, its information, we experience its guidance. We can live according to our deepest meditation-derived insight into its implications. The information state of the universe, the *Dhamma*, manifests in materials but is not itself material. The *Dhamma* is the pathway from the physical, chemical, biological world, to the non-material.

Today we are lucky that the language and concepts of science encourages us to pull up alongside an unborn, unending, un-originated, non-material *Dhamma* to guide our traverse. The universe provides us information, which we can access directly through meditative, non-reactive self-observation, which awakens insights by which we can know who and what we really are.

Vipassana meditation is observation of sensations without the state of reaction. The Buddha taught in the Mahasatipatthana Sutta that Vipassana reveals that in seeing, there is only seeing, that in hearing, there is only hearing. There is no one sending the signal of *Dhamma* but there is a signal. There is no one hearing the signal, but it arrives. In the Twenty-First Century, it is science, not mysticism, to recognize that we are products of a cosmic information-state that can lead us beyond its own material manifestations.

Paul R. Fleischman

is the author of:

Wonder: When and Why the World Appears Radiant, and other books.

Vipassana Courses

Courses of Vipassana meditation, as taught by S.N. Goenka in the tradition of Sayagyi U Ba Khin, are held regularly at permanent centers and at rented sites in many countries throughout the world. Information, schedules and application forms are all available from the website www.dhamma.org.

About Pariyatti

Pariyatti is dedicated to providing affordable access to authentic teachings of the Buddha about the Dhamma theory *(pariyatti)* and practice *(paṭipatti)* of Vipassana meditation. A 501(c)(3) non-profit charitable organization since 2002, Pariyatti is sustained by contributions from individuals who appreciate and want to share the incalculable value of the Dhamma teachings. We invite you to visit www.pariyatti.org to learn about our programs, services, and ways to support publishing and other undertakings.

Pariyatti Publishing Imprints

Vipassana Research Publications (focus on Vipassana as taught by S.N. Goenka in the tradition of Sayagyi U Ba Khin)

BPS Pariyatti Editions (selected titles from the Buddhist Publication Society, co-published by Pariyatti in the Americas)

Pariyatti Digital Editions (audio and video titles, including discourses)

Pariyatti Press (classic titles returned to print and inspirational writing by contemporary authors)

Pariyatti enriches the world by

- disseminating the words of the Buddha,
- providing sustenance for the seeker's journey,
- illuminating the meditator's path.